DOCUMENT RESUME

ED 388 385 PS 023 643

AUTHOR Hong, Eunsook
TITLE Preservice Elementary Teachers' Conceptions about Teaching Word Problem Solving: The Effect of Methods Instruction.
PUB DATE Apr 95
NOTE 32p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, April 18-22, 1995).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Concept Formation; Elementary Education; Higher Education; *Instructional Development; Knowledge Base for Teaching; Mathematics Achievement; *Mathematics Instruction; Mathematics Materials; *Mathematics Teachers; Methods Courses; *Preservice Teacher Education; Teaching Methods; Teaching Skills; *Word Problems (Mathematics)
IDENTIFIERS Lesson Structure; *Preservice Teachers

ABSTRACT

This study revealed some of the factors that influence preservice elementary teachers' instructional planning in word problem solving by examining preservice teachers' conceptions of how to teach word problem solving. Twenty-one interviews of preservice teachers were conducted before and after the mathematics methods course and the protocols were categorized into a set of constructs elicited from their statements regarding instructional planning and processes by examining similarities, differences, and changes in individual interview statements. Three general conceptions expressed by preservice teachers were instructional strategies, concerns about student ability, and past experiences. While some preservice teachers showed certain conceptual changes in their instructional planning after the methods instruction, others were consistently influenced by other factors such as their prior educational experiences. Many preservice teachers were concerned about students' prerequisite levels in instructional planning and were aware that they were not equipped with the necessary knowledge. Fewer preservice teachers mentioned incorporating their own personal experiences in instructional planning at the end of the methods course. Contains 40 references. (Author/AP)

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Preservice Elementary Teachers' Conceptions About Teaching Word Problem Solving: The Effect of Methods Instruction

Eunsook Hong

College of Education

University of Nevada, Las Vegas

April, 1995

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Paper presented at the 1995 American Educational Research Association Annual Meeting, San Francisco.

Correspondence concerning this article should be addressed to Eunsook Hong, Department of Counseling and Educational Psychology, University of Nevada, Box 453003, Las Vegas, NV 89154-3003.

PS 023643

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Abstract

This study attempted to understand some of the factors that influence preservice elementary teachers' instructional planning in word problem solving by examining preservice teachers' conceptions of how to teach word problem solving. Twenty-one preservice teachers' interview protocols were categorized into a set of constructs elicited from their statements regarding instructional planning and processes. To investigate the effect of the mathematics methods instruction on their conceptual changes in teaching problem-solving, changes in frequencies of constructs elicited from all participants before and after the mathematics methods course and similarities, differences, and changes in individual interview statements were examined. Three general conceptions expressed by preservice teachers were instructional strategies, concerns about student ability, and past experiences. While some preservice teachers showed certain conceptual changes in their instructional planning after the methods instruction, others were consistently influenced by other factors such as their prior educational experiences. Many preservice teachers were concerned about students' prerequisite levels in instructional planning and were aware that they were not equipped with the necessary knowledge. Fewer preservice teachers mentioned incorporating their own personal experiences in instructional planning at the end of the methods course.

Preservice Elementary Teachers' Conceptions About Teaching Word Problem Solving: The Effect of Methods Instruction

Results of the National Assessment of Educational Progress indicated that significant mathematical problem solving deficiencies exist in elementary and secondary grades (Dossey, Mullis, Lindquist, & Chanbers, 1988). Among the mathematical problems, word problem solving seemed to represent considerable difficulty for many students. Numerous international studies of academic achievement also indicated poor performance by American students especially in mathematics (e.g., Baker, 1993; Garden, 1987; Educational Testing Service [ETS], 1992; Schaub & Baker, 1991; Stevenson, 1987; Stevenson, Lee, & Stigler, 1986). Among the factors identified in explaining the low performance of American students in mathematics included the quality of time spent at school, curriculum coverage, and teaching methods. The students' poor performance is also attributed to the results of teachers' misunderstandings of basic mathematical concepts and misconceptions about which skills deserve to be emphasized (Good & Grouws, 1987).

Teachers' conceptions about teaching mathematical problem solving influence the way they plan instruction in word problem solving. Burns and Lash (1988) indicated that in planning problem-solving instruction, teachers were more concerned about the selection of materials and problems than about how to teach actual problem solving, and that the preferred teaching techniques for mathematics in general were to show students how to work problems and then to allow students to practice more problems of the same type. Teachers'

selection of specific tasks in instruction affects student learning. Students learn and retain better those contents which are particularly emphasized by their teachers. Renkl and Helmke (1992) compared performance of students who were taught by teachers of two groups: one group who taught mathematics with performance-oriented tasks which promote automatization of basic arithmetic skills and another with structure-oriented tasks which foster knowledge of principles and of the rationale underlying procedures. Students in the performance-oriented tasks group performed better in basic arithmetic skills, while students in the structure-oriented tasks group performed better in tests where problem-solving was required. These findings show that students learn more of those contents which are especially emphasized by the teacher, indicating the importance of teachers' task selection in instruction.

Teacher knowledge--content knowledge, content specific pedagogical knowledge, general pedagogical knowledge, and curriculum knowledge (e.g., Shulman, 1986)--also influences teachers' instruction and instructional planning. In discussing preservice teachers' content knowledge, Tirosh and Graeber (1990) contended that unless preservice teachers become aware of their own misconceptions and inconsistencies, some inconsistencies may go unchallenged from teacher to student. Although empirical research on the direct relationship between teachers' and students' misconceptions has not been conducted, a large number of studies indicated that elementary and secondary students (Bell, Fischbein, & Greer, 1984; Bell, Swan, & Taylor, 1981; Brown, 1981; Garofalo, 1992; Hong, in press) and preservice teachers (Ball, 1990; Graeber, Tirosh, & Glover, 1989; Thipkong & Davis, 1991; Tirosh &

Graeber, 1990, 1991) bring various misconceptions into classrooms or develop misconceptions in the course of learning new materials. Borko and Livingston (1989), Simon (1993), and Thipkong and Davis (1991) discussed the importance of knowing preservice teachers' weaknesses in order to help them be better equipped with content knowledge in preparation for teaching students.

Teachers' knowledge of their own students affects instruction and instructional planning by allowing teachers to better tailor instruction to students' knowledge and problem-solving abilities. In their study of teachers' knowledge of students' knowledge in mathematics problem solving, Peterson, Carpenter, and Fennema (1989) found that teachers with more knowledge of their students "questioned" students about problem-solving processes and "listened" to their responses. Teachers with less knowledge of their students "explained" problem-solving processes to students or "observed" students' solutions. While the novice teacher paid little attention to student cognition, the expert teacher incorporated her knowledge of student thinking in her instruction by, for example, providing verbal presentation and picture that were dependent upon a situational context that the children understood well (Lehrer & Franke, 1992).

The way preservice and inservice teachers accumulate their teacher knowledge and beliefs is affected by their prior educational experiences including elementary, secondary, and teacher education as well as their life experiences and current teaching experiences (Perry, 1990). These knowledge and beliefs are not necessarily effective or consistent with their education in teacher preparation but appear to be highly stable and resistant to change

(Kagan, 1992). Comparing his study on preservice elementary teachers' knowledge of elementary mathematics with the previous studies with preservice and precollege students, Simon (1993) indicated that these studies revealed conceptual difficulties that were consistent throughout the precollege students and preservice teachers and that it was in precollege mathematics classrooms, for the most part, that these prospective teachers developed their mathematical understandings. Comparing views and learning of pedagogical content knowledge of students from three different preservice teacher training groups, Meredith (1993) found that students' views were less likely to be influenced by a lengthy training course, but more likely to be based upon prior knowledge and experiences, especially school experiences. These studies indicated that knowledge accumulated from the prior school and life experiences is difficult to alter even with carefully planned teacher preparation programs.

Studies on the effects of teacher education programs on the teaching practices have revealed contradictory conclusions. Regan and Hannah (1993) maintains that a teacher preparation program has a lasting impact on the new teachers' planning and teaching. They observed and interviewed the graduates of their teacher education program and found a consistent connection between the philosophy and pedagogy of the program and the practice of its graduates. Veenman (1984) also claims that most new teachers hold some connection to their teacher preparation. However, other studies (e.g., Kagan, 1992; Palonsky & Jacobson, 1988; Ross, 1987) suggested that teacher education had a marginal influence on teachers' perspectives on teaching. Wilson and Readence (1993) indicated that although a teacher education program affected some preservice teachers' perspectives and practice of social

studies, their perspectives and practice were influenced and altered by the cooperating teachers and their background and prior educational experiences. Beginning teachers' knowledge of pedagogical procedures was more influenced by their own early school experiences than by learning experiences from their teacher education program (Fennema & Franke, 1992).

There also have been attempts to develop better teacher education programs by investigating the effects of these programs. McDevitt, Heikkinen, Alcorn, Ambrosio, and Gardner (1993) implemented a special preservice education program for science and mathematics and compared preservice students in the special program to those who were in the ordinary teacher education program. Students in the special program demonstrated enhanced attitudes toward teaching science and mathematics, and showed more beliefs about effective teaching that could be found in experienced teachers (e.g., more concern for particular instructional strategies).

The present study attempted to understand some of the factors that influence instructional planning in word problem solving by examining preservice teachers' conceptions of how to teach word problem solving. Preservice teachers' interview protocols were categorized into a set of constructs elicited from their statements regarding instructional planning and processes. To investigate the effect of the mathematics methods instruction on their conceptual changes in teaching problem-solving, the interview was conducted both at the beginning and at the end of the mathematics methods course. Changes in frequencies of constructs elicited from all participants before and after the methods course and similarities,

differences, and changes in individual interview statements were examined so as to understand the preservice teachers' conceptions and the factors that influence their instructional planning.

Method

Participants and Setting

The participants in this study were 21 preservice elementary teachers who were enrolled in the mathematics methods course at a large western university. The course content of the methods course included current methods and materials for teaching elementary school mathematics, including a review of content and curriculum, recent trends and issues, developmental learning, and diagnostic and prescriptive teaching. The classroom was organized as a mathematics laboratory, which had tables for the students to work in groups and was equipped with manipulatives and other materials appropriate for the mathematics methods instruction. All participants had previously taken two or more college mathematics content courses and at least one practicum course. All but one participant was female and all participants had volunteered for the study.

Materials and Procedure

The materials were a set of five elementary arithmetic word problems involving multiplication and division. One problem involved subtraction. The information in each problem included the numerical values of three quantities (whole numbers). To find the answer, a whole number, two of the three arithmetic operations were applied to the three given numbers. Among these problems, two (Problem 4 and 5) were used for interviewing

their conceptions of how to teach problem-solving (see Table 1). The other three were used as warm-up problems.

Insert Table 1 about here

In order to determine whether preservice teachers would use different instructional strategies for different problem situations, Problem 4 and Problem 5 involved "cookies" and "ribbons," respectively. Also, Problem 4 cannot be solved using simple forward solution strategy, while Problem 5 can be.

Each participant solved the five problems while thinking aloud and then was asked to teach the last two problems assuming that he or she was teaching in a classroom of 6th-graders. Each problem was presented separately on a worksheet. Each subject's responses for the entire session were tape-recorded. To gain an understanding of preservice elementary teachers' general views about teaching word problem solving, the investigator did not provide a specific set of leading questions on instructional planning such as materials, activities, and classroom operation.

Data Analysis

Interview was analyzed in four steps. First, the interview contents were transcribed. Next, in order to compile participants' protocols, categories of constructs were identified. Categories and subcategories of constructs were elicited from the preservice teachers' statements regarding problem-solving instructional planning and processes. Next, each

participant's protocols were reanalyzed and mapped onto the categories to quantify their relative occurrences and to determine whether there were differences between the pre- and post-methods instruction. Lastly, the participants' statements were organized according to the categories identified earlier so that the examples of each of the categories can be provided.

Results

Categories of Constructs

Preservice teachers' conceptions about teaching word problem solving were elicited from their interview protocols. The focus of the study was to understand how preservice teachers plan word problem solving instruction and the factors that influenced their decisions provided that no leading questions were used. Interviews were held in two sessions (i.e., at the beginning of the mathematics methods course and at the end) in order to examine the influence of methods instruction in their instructional planning.

Three general categories emerged from the analyses of participants' statements: (1) instructional strategies, (2) concerns about student abilities, and (3) past experiences. The subcategories of problem-solving instructional strategies were (a) emphasis on understanding the problem situation, (b) verbal presentation of problem-solving processes, (c) use of manipulatives in instruction, (d) use of diagrams/pictures in instruction, and (e) acting out. In addition to one of the above strategies, a few participants wanted to use additional instructional strategies (e.g., grouping, use of small number, writing an equation, use of overhead projector, asking students what methods/materials they wanted to use).

Concerns about student ability included (a) uncertainty about the students' entry level

knowledge/skills and (b) presumption about the students' entry level knowledge/skills. Past experiences included (a) prior educational experiences and (b) teacher education experiences (practicum or methods course).

Instructional strategies

The frequencies of constructs within each subcategory of instructional strategies are presented in Table 2 for the pre- and post-methods sessions.

Insert Table 2 about here

Although not one preservice teacher mentioned the importance of understanding the problem situation at the beginning of the methods course, three did at the end of the methods course. In the post-methods session a participant stated, "First, I would have them... ah... get... understand the problem. I would have them to look for information that is relevant, and decide what they are looking for...." In the pre-methods session, this participant merely described computational processes needed to solve word problems.

In general, more participants indicated that they would use only verbal presentation rather than other methods (e.g., use of manipulatives) in teaching the type of problems provided in the current study. However, the use of different instructional strategies were dependent upon the entities in the problem situations, that is, the size of the figures (122 cookies, 105 ribbons) or whether the problem involved "cookies" or "ribbons." For example, although the frequencies for using any kind of manipulatives in teaching Cookies

and Ribbons problems became similar by the end of the methods course (n = 6 and n = 7, respectively), in the pre-methods session there were fewer participants who wanted to use manipulatives for Cookies problem (n = 4) than for Ribbons problem (n = 10) (see Table 2). Among these preservice teachers, there were apparent pre- and post-session changes in the frequencies between Cookies and Ribbons problems in terms whether they would use actual cookies or ribbons or other materials that represent them. In the pre-methods session, there were two and six preservice teachers who wanted to use the actual cookies and actual ribbons, respectively, and two and four for other materials that represent cookies and ribbons, respectively. However, in the post-methods session, five preservice teachers in both Cookies and Ribbons problems said that they would use the materials that represent them instead of actual cookies or actual ribbons. Only one and two wanted to use the actual cookies and ribbons, respectively, in the post-methods session. The main reason for these apparent differences between the use of actual cookies and ribbons in the pre-methods session was that preservice teachers were concerned about a possible classroom disruption that could be caused by using actual cookies in instruction (e.g., students will eat them; class will get noisy). This difference was decreased in the post-methods session and most of these teachers changed from using real materials to any other materials that represent cookies or ribbons.

The reasons given by preservice teachers who planned to use only verbal presentation in word problem solving were varied: (a) because sixth graders know division, they would not need manipulatives (n = 1 and n = 2 for the pre- and post-methods session, respectively, only in Cookies problem); (b) because the size of the figure is too large (n = 2

for both Cookies and Ribbons problem, but mentioned only in the pre-methods session); (c) because verbal presentation of problem-solving processes by organizing information, and/or using keywords would suffice for teaching the type of word problems presented in the study ($\underline{n}$ = 7 and $\underline{n}$ = 11 in Cookies problem for pre- and post-methods session, respectively; $\underline{n}$ = 4 and $\underline{n}$ = 9 in Ribbons problem for the pre- and post-methods session, respectively); and (d) because students will eat the cookies and/or it will be noisy ($\underline{n}$ = 2 and $\underline{n}$ = 1 for the pre- and post-methods session, respectively, only in Cookies problem).

Six participants consistently wanted to use only verbal presentation in both pre- and post-methods sessions with the same reason for at least one of the two problems. A participant, for example, wanted to teach the way she solved the problem by stating, "... I will pretty much teach it the way I came about. Figuring it out, taking it each step by each step, writing down ..., and I go through each sentence...." This statement was consistent in both pre- and post-methods sessions. Five participants also wanted to use only verbal presentation in both pre- and post-methods sessions, but with different reasons in each session. For example, one participant wanted to teach verbally in the pre-methods session because the figures involved in the problem situations were too large to use any materials. But this participant placed emphasis on organizing information and teaching problem-solving processes in the post-methods session.

Six participants wanted to use verbal presentation only, but for only one of the two sessions. One participant in the pre-methods session decided this because cookies will leave all the crumbs in her class. This participant later in the post-methods session wanted her

students to choose how they want to solve the problem, by stating, "I will let them decide how they want to do that. If they want to do division [computation], or if they want to draw pictures and deal out each cookie, or if they want to use manipulatives. I guess, they could use that." A participant who wanted to teach verbally in the post-methods session began her instruction by stating, "Let's read the problem together. Cathy had 105 pieces of ribbon. So, I am going to write that down." While talking out loud, she wrote the information on her worksheet. "The next step in the problem is... she divided the pieces of ribbon equally into 5 piles [reading the problem].... Okay... Now, if you are going to divide pieces of ribbon equally into 5 piles, okay, now if you want to divide ribbon equally into 5 piles, how would you go about that?" Then she followed the steps for division. This participant said in the pre-methods session that she would give students ribbons, although she was not sure whether it would be the right method or not.

It is worth noting that although three participants stated in the pre-methods session that they would use verbal presentation because of the size of numbers in the problem situations, none of these participants stated the same reason for using verbal presentation in the post-methods session (i.e., two participants stated that if students know the division, teaching problem-solving processes is good enough) or for not using verbal presentation (one participant wanted to use actual cookies and ribbons).

A few preservice teachers who wanted to use manipulatives for problem-solving instruction also mentioned that they would use other strategies with manipulatives. In the post-methods session, three participants indicated that they would group the students for

problem-solving activities. A participant stated, "... They would have their own tables or desks, and I probably have the kids work in at least groups of two, probably more than two. I think sixth graders would be able to do that pretty well...."

Four participants in the pre-methods session indicated that they would use a small number of cookies/ribbons. For example, one participant described, "... First I have to do is scale it down, you know, so to show, just to show the procedure so that they can at least see with what I am doing with the process, and then I want to show them ribbons... 10 or 20 at the most...." This participant did not mention the use of manipulatives at all in the post-methods session, but emphasized the teaching of processes, especially by using keywords in the problem situation.

In both Cookies and Ribbons problems, two and four participants in the pre- and post-methods session, respectively, mentioned describing the problem mathematically by writing an equation after hands-on activities. A participant described how she would let the students use manipulatives to solve the problem and then write an equation by stating, "... We would then go from there into how to use the symbols [numbers/equation] to show the concepts, for how the numbers represent the manipulative pieces and vice versa...."

Two participants in the post-methods session stated using other instructional media in addition to hands-on activities for both Cookies and Ribbons problems. One participant stated that she would also use an overhead projector (OHP) to show concepts by the teacher and/or ask children to come up and play with OHP materials. The other commented that she would start instruction with concrete materials and later with the paper work only.

Four participants in the pre-methods session stated that they would let students act out on the problem. Two of these also mentioned the use of OHP along with the acting-out procedure. None of the participants included an acting-out strategy in the post-methods session.

Ten and eight participants in the pre- and post-methods session, respectively, stated that they would use diagrammatic representations in problem-solving instruction. However, only one participant mentioned diagrams in both pre- and post-methods sessions. For example, two participants in the pre-methods session said that they would use diagrams for Cookies problem because students may eat them. These two did not want to use diagrams in the post-methods session (one wanted to use manipulatives and the other explained the problem-solving processes). One participant stated the use of diagrammatic representation in the post-methods session, while she wanted to use manipulatives in the pre-methods session.

Two participants in each pre- and post-methods session who wanted to use manipulatives also mentioned that whether to use manipulatives or not would depend on the students' ability levels. That is, manipulatives would only be used in their instruction, if students can not solve the word problems. On the other hand, one participant in the pre-methods session said that she would not use manipulatives for this level of students, but would consider using them if the students do not know the division. The same person wanted to use manipulatives in the post-methods session stating that "Probably I would give them 105 pieces of ribbon so they can see it... easier to see it... hands-on materials ... and after they have done a few times with hands-on materials, I think they realize how to divide...."

Only one participant described in the post-methods session the importance of verification after solving the problem: She would ask students to double-check their work by rereading the problem and making sure that the solution was correct.

Concerns About Student Ability

Eight and nine participants in pre- and post-methods session, respectively, mentioned about their concerns about student abilities for solving division problems. Two subcategories emerged were (1) uncertainly and (2) presumption about the students' entry level knowledge/skills in instructional planning. Seven and five participants in the pre- and post-methods session, respectively, expressed that they did not have a firm knowledge about the students' entry level and/or that the instruction should be accommodated according to the students' abilities for solving division problems. A participant in the pre-methods session started her instructional planning by stating, "Well, it depends on what levels they bring in.... Sixth graders... they should be able to multiply. However, I have to find out first they could do that. If not, then I have to back up and start with multiplication and proceed to division until they have grasp of the basic concept...." This participant showed a similar concern in the post-methods session. Three participants in each pre- and post-methods session also expressed a similar concern about the students' entry level, among which one participant expressed in both pre- and post-methods sessions.

Two participants in the pre-methods session (but not in the post-methods session) stated that they do not know how much sixth graders know about multiplication and/or division. They went on planning instruction assuming that students know multiplication and

division concepts. A participant at first assumed that the students would know the fraction concept. But then this participant was not sure as to what method she should use for the sixth graders. She stated, "I am not really sure what sixth graders are... now... you know... what they know about fractions...." She tried to relate her instruction with the ability level of students. One participant in both pre- and post-methods sessions said that she hoped students knew multiplication and division and went on planning instruction on that assumption.

On the other hand, one and four participants in the pre- and post-methods session, respectively, planned instruction presuming that sixth graders know division already. They were certain about the knowledge level sixth-grade students will bring into the classroom, but without concerning that there might be individual differences among students. Although these participants presumed that students know how to solve division problems, their instructional approaches were different (e.g., only verbal instruction, use of OHP or diagrams). Among these, only one participant had the same opinion in both pre- and post-methods sessions. One participant in the post-method session stated that manipulatives or pictures may be used only for lower graders, but not for sixth graders.

Past Experiences

Without leading questions given by the interviewer, some participants voluntarily mentioned the reasons for using particular strategies. Those reasons related to their past experiences were categorized into two subcategories. They included prior educational experiences and teacher education experiences (practicum or methods course). The interview protocols as well as frequency changes in each of these two subcategories before and after

methods instruction would give us some idea on whether the changes were partly due to the methods instruction.

In the pre-methods session, there were five participants who mentioned that the reasons why they would teach in certain ways were due to their prior educational experiences. However, there was only one participant who said the same reason in the post-methods session. Two participants in the pre-methods session mentioned that they would teach the same way as they learned before. A participant started planning instruction by stating, "I would take it step by step, because that's the way I learned, step by step. I will, you know, introduce the question, then... start talking about 105 pieces of ribbon...." This participant changed her strategy in the post-methods session and used manipulatives in her instruction. The other participant in the pre-methods session said that she would teach by drawing things because that's how she learned. This person in the post-methods session explained the problem-solving processes (i.e., understand the problem, devise a plan, solve the problem), but still used pictures in her instruction.

An interesting change was found with a participant who started instruction in the pre-methods session by using a small number of manipulatives. This participant changed her strategy from the manipulatives use to the verbal presentation of solution processes in the post-methods session by stating, "... It's much more clear probably to go over.... That's basically all I know. I was taught that, you know. That's basically what I am familiar with." Although the mathematics methods course covered word problem solving, she wanted to teach the way she had been taught as a student in public school.

Three participants in the pre-methods session stated that they would draw a picture or use manipulatives because they are a visual or kinesthetic learner, and that is the way they solved word problems. No one mentioned in the post-methods session their own learning styles as the reason for using certain strategies.

Only one participant mentioned her practicum experience in instructional planning. In her pre-methods session, a participant stated at first that sixth graders should be able to solve the problem by hand. But later she mentioned that she was not sure how to approach the problem because she was amazed to find in her practicum that fifth-grade students could not do what she thought they should be able to do.

Two participants changed the instructional strategies in the post-methods session because of what they have learned in the mathematics methods class. A participant stated, "Now that I know more about math manipulatives, I might have them draw that out..., or give them pieces to work with them.... So, I'd give them 105 pieces so they can see what they are doing. Probably easier for them." The other participant stated, "We just went through problem-solving and other standard problems.... I would probably approach it using that type of model, which is understand the problem, and then devise the plan, and carry out the plan, and ...."

Discussion

Studies with respect to preservice teachers' conceptions about teaching certain subject matters are important if teacher education programs are to develop methods instruction/course that will help preservice teachers extend their proper conceptions and

modify their misconceptions. The purpose of the current study was to understand conceptions about teaching word problem solving and some of the factors that influence preservice teachers' instructional planning. Factors were elicited by examining the interview protocols on their instructional plan, with particular attention given to elicit their general conceptions about teaching word problem solving. That is, what general conceptions the preservice teachers bring into the mathematics methods class and what conceptions they have kept or modified by the end of the methods class.

The preservice teachers expressed three general conceptions when they were given word problems to teach. They were instructional strategies, concerns about student ability, and past experiences. While some preservice teachers showed certain conceptual changes in their instructional planning after the methods instruction, others were consistently influenced by other factors such as their prior educational experiences. Although some participants did not state why certain instructional strategies were adopted in the post-methods session, the influence of the methods instruction on changes in their conceptions was apparent in some participants. For example, while not one preservice teacher mentioned the importance of understanding the problem situations in the pre-methods session, three did in the post-methods session. More naive views were expressed in the pre-methods session (e.g., they would not use manipulatives because the figures were too large; students will eat the cookies), while more advanced views were expressed in the post-methods session (e.g., writing an equation after hands-on activities; use of grouping; use of more than one media; use of manipulatives that represent the actual materials). It is worth noting that many

preservice teachers' material selection in instructional planning was influenced by the entities of problem situations (e.g., size of figures, cookies or ribbons). The methods instruction may include an instructional topic of material selection for various problem situations.

While some preservice teachers were concerned about the students' entry level ability in their instructional planning, others presumed that students know the division without considering that there may be individual differences among students. More preservice teachers assumed uniform entry level in the post-methods session than in pre-methods session, and more preservice teachers were concerned about the individual differences in pre-methods session than in post-methods session. These findings indicated that many preservice teachers were concerned about students' prerequisite levels in instructional planning for word problem solving and were aware (or unaware) that they were not equipped with the necessary knowledge. Thus, the mathematics methods instruction should deal with the concept of individual differences in students abilities in the course.

By the end of the methods course, fewer preservice teachers mentioned incorporating their own personal experiences in instructional planning. Preservice teachers who wanted to teach in a certain way in the pre-methods session because that is the way they had learned before or because that is the way they had solved problems and it had worked, did not express the same reasons in the post-methods session. In addition, two preservice teachers specifically mentioned the new learning they received from the methods class as the reason they were changing the instructional strategies in the post-methods session. However, a preservice teacher expressed desire to conform to the way she was taught after the methods

instruction. This is not surprising as other researchers also have found that preservice teachers get the idea of how to teach while in their early schooling (Ball, 1990; Thompson, 1992). For example, Civil (1993) used her class in her study by structuring the course in a way to provide exploratory approach to mathematics, but she found that students still retained their traditional views about teaching mathematics that may have resulted from their experience with the traditional school mathematics. These studies indicate that influence of past experiences has long lasting effects on conceptions and practices of teaching. Posner, Strike, Hewson, and Gertzog (1982) also noted that it is the learner's resistance to a conceptual change that could accommodate long lasting inconsistencies. Learning new knowledge and skills that are consistent with the learner's existing knowledge from their past experiences may be easier than the type of learning that requires conceptual change.

Although, in this current study, more preservice teachers changed their teaching strategies after methods instruction, whether this apparent influence of the methods instruction on instructional planning continues in their own future classroom practices should be further investigated.

In conclusion, the current study supports previous findings that the methods course affected some preservice teachers' conceptions about teaching (Adler, 1982; Wilson & Readence, 1993). However, some preservice teachers' conceptions were consistently influenced by other factors such as their prior educational experiences (Civil, 1993; Johnston, 1990; Ross, 1987, Wilson & Readence, 1993). Although the study is limited by the short duration of the investigation (a semester), thus further studies are necessary to determine the

long-term influence of the methods instruction, the study clearly indicated that methods instruction influenced preservice teachers' conceptions about teaching word problem solving. However, in the light of the different views and concerns expressed by the preservice teachers in the study, teacher educators must make efforts (a) to understand what pre-conceptions preservice teachers bring into methods classes, (b) to check whether the methods instruction has an effect on their conceptual change, and (c) to help them become aware of their own conceptions and conceptual changes.

More constructs might have been elicited if specific leading questions about instructional strategies and other important factors involved in word problem solving were provided. However, it was the purpose of this study to find the elements of preservice teachers' mental structures when no prompts were given and thus eliciting their original thoughts about teaching word problems solving. Future research could focus on examining the preservice teachers' conceptions with prepared interview items which reflect the investigator' theoretical framework.

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Table 1

Problems Used in Eliciting Conceptions About Teaching Word Problem Solving

Problem 4:	Susan ate 7 cookies while she was putting them into piles of 5 cookies each. Susan had 122 cookies to start. How many piles of cookies were there?
Problem 5:	Cathy had 105 pieces of ribbon. She divided the pieces of ribbon equally into 5 piles. Bobby took one of the piles of ribbon and divided it into 3 equal piles. How many pieces of ribbon were in each of the piles which Bobby made?

Table 2

Frequencies of Constructs Within Each Subcategory of Instructional Strategies Stated by Preservice Teachers for the Pre- and Post-Methods Sessions

	Cookies problem		Ribbons problem	
Strategies	Pre-method	Post-method	Pre-method	Post-method
Understanding problem	0	3	0	3
Any manipulatives[a]	4	6	10	7
Actual materials	2	1	6	2
Other materials	2	5	4	5
Verbal instruction only	13	14	8	10
Act out[a]	1	0	1	0
Diagrams/pictures[a]	3	1	2	3

[a]Some of the participants used other instructional strategies in combination with these strategies (descriptions follow in the text).